DESIGN REPORT
INSPECTION PLAN
OPERATION AND MAINTENANCE PLAN
AND
POST CONSTRUCTION MONITORING PLAN

REVISED DESIGN STRUCTURE #1

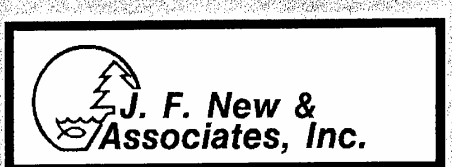
FOR THE

LAKE MANITOU ASSOCIATION, INC.
ROCHESTER, INDIANA

LAKE MANITOU, GRAHAM DITCH WETLAND PROJECT

REVISED PER IDNR COMMENTS
DECEMBER, 1997

J. F. NEW & ASSOCIATES, INC.
Environmental Engineers/Biologists/Planners/Consultants
Walkerton/Indianapolisndiana



SECTION I

DESIGN REPORT

A. Location

The Lake Manitou, Graham Ditch Wetland Project is located approximately 2 miles east of the City of Rochester on the east side of Lake Manitou. The project lies in the N 1/2 of Section 14, Township 30 North, Range 3 East, Rochester Township, Fulton County, Indiana. The Graham Ditch flows into Lake Manitou approximately 1/4 mile downstream (west) from the project area and the project area extends 3700 ft. upstream (east) of the Structure #1 water control structure.

The drainage area for the discharge point is approximately 7 square miles. The land use in the contributing watershed is primarily agricultural.

B. Project Objective

The Lake Manitou Association, Inc. has proposed an enhancement system to improve the quality of water entering Lake Manitou. The treatment system consisting of one sediment basins and two detention areas is necessary to reduce the amount of sediment and nutrient loading occurring in the lake. The lake enhancement system will be constructed in the Graham Ditch channel and its adjacent floodway.

The concept behind detaining water in a wetland detention area or sedimentation basin is to reduce the suspension and transportation energy of moving waters. Water in motion has the capacity to scour and transport fine sediments (silts and clays) long distances before deposition. While a basin that has an inflow and an outflow cannot hold water motionless, the energy can be reduced sufficiently to facilitate the fallout of sediment from the water column.

Additionally, the wetland detention area will remove nutrients from the runoff through uptake by the wetland plant species and the bacteria they support.

The following concepts were considered are for optimal sedimentation basin and/or wetland detention area.

- Significantly reduce the horizontal velocity of the water column.
- Reduce velocities of the inflow water velocity as it enters the basin to encourage sheet flow, rather than turbulent, channelized flow.
- Encourage the uniform distribution of flow throughout the entire volume of the wetland detention area.

- Maximize contact of water with the substrate and vegetation in the wetland systems to facilitate efficient nutrient uptake.

- Store as much water as possible, for as long as possible, from the largest feasible storm event.

- Structural stability and longevity. Resistance to hydraulic stress and erosive scour.

- Reduction of operation and maintenance costs.

- Maximize safety of the system operation, maintenance and monitoring personnel and the general public.

- Optimize the sites for wildlife habitat suitability, if within construction budget.

- Minimize construction costs.

C. General Project Description

The project involves constructing two water control structures in the Graham Ditch. One structure will be an earthen embankment incorporating a piling water control structure with rip rap and gabion spillways. The second structure will be a steel sheet piling with steel grating used to dissipate energy in the overflowing water. The purpose of the structures are to re-establish normal pool areas and flood detention areas within an existing channelized wetland area. The structures will provide approximately 4 acres of normal pool area and 32 acres of flood detention pool area. Earth embankment baffles will also be constructed across the ditch channel upstream of the structures to divert flood waters into the wetland flood detention area. The sediment basin will be constructed to assist with normal flow sediment removal in the existing ditch channel. The trap will also collect larger sediment during peak flows and help maintain the integrity of the wetland. All embankments and areas disturbed during construction will be seeded or planted with species suitable to the wetland area.

D. Hydrology and Hydraulics

1. Hydraulic Model - Assumptions and Criteria

The Indiana Department of Natural Resources, Division of Water completed determination of the separate water discharges and the hydrographs of different storms, of the Graham Ditch in Section 14, Township 30 N., Range 4E., at a point 200 feet east of the west section line in Fulton County in July 1988. The drainage area is 6.96 square miles. The peak discharges are as follows:

Storm (year)	Discharge (cfs)	Time to Peak (hrs)
100	400	14.70
50	300	15.00
10	150	15.50
5	100	15.80
2	50	16.50

The objective is to construct a wetland at the Graham Ditch Site which is designed to reduce water flow velocities in the ditch and increase detention and contact time within the wetland system. The objectives of the design are to reduce nutrient laden suspended solids through the use of sediment basins and detention within the wetland. The wetland should also biologically remove dissolved nutrients, contaminants, and COD from the flow in the Graham Ditch.

The proposed conditions model was developed assuming final construction of the lake enhancement project. The model represents water control structures that were only present in the effective flow areas of the flood waters.

2. Study Results

The pond routing analysis was performed using Haestad Methods Pond-2 (Detention Pond Design & Analysis). The first dike and weir structure (Structure #1) that is proposed in the channel will create a normal water pool elevation of 782.0 and have a normal pool area of 3.50 acres. The routing analysis is as follows:

Storm (year)	Peak Outflow (cfs)	Time to Peak (hrs)	Elevation (ft.)	Pool Area (ac)
100	369.57	16.10	784.59	17.58
50	259.38	16.70	784.02	16.66
10	136.21	16.80	783.42	10.88
5	84.18	16.80	783.10	6.04

The second dike and weir structure (Structure #2) that is proposed in the channel will create a normal water pool elevation of 784.0 and have a normal pool area of 0.83 acres. The routing analysis is as follows:

Storm (year)	Peak Outflow (cfs)	Time to Peak (hrs)	Elevation (ft.)	Pool Area (ac)
100	378.71	15.30	787.01	14.17
50	261.87	15.70	786.50	12.01
10	139.08	16.20	785.84	8.27
5	86.33	16.10	785.48	4.92
2	32.56	16.90	784.96	1.75

3. Conclusions

The effects of the proposed lake enhancement conditions were analyzed and compared to the existing conditions of the Graham Ditch. Based on the results of the comparison the flow velocities will be reduced, which will reduce nutrient laden suspended solids within the wetland. The design is an economical, natural low maintenance method of treating the waters of the Graham Ditch prior to discharge into Lake Manitou.

E. Structural Stability analysis

1. Steel Sheet Piling

Given the simple nature of the designed sheet piling weirs there is no structural foundation supporting weight. The only structural considerations involved in the designs of the weirs are the depth to which the sheet piles are to be driven into the earth. The depth below the ground surface to drive the steel sheet pilings were based on the stability characteristics of the soil strata in the project sites. Because of the nature of the soils, the limiting factor to the stability of sheet piling was the minimum depth to which sheeting was to be driven rather than the strength of materials. The materials specified are typically used in much more severe applications.

2. Earth Embankments

The embankments have been designed with 3:1 side slopes as recommended in the SCS Technical Field Guide for earthen berms. The top width of the berms has been set at 8 to 10 feet to allow for easy construction equipment access. The earthen berms, except those located adjacent to the hydraulic control structures, will be stabilized with appropriate vegetation. The vegetation will anchor into the berm and hold the soil in place. At the outlet locations, the earthen berms will be stabilized with gabions and rip rap on the upstream and downstream sides of the structures. This will prevent scouring and undermining of the toe of slope from erosive discharge forces.

F. Environmental Concerns

1. Wetlands

Due to the nature of the proposed projects, it is necessary to construct portions of the projects in jurisdictional wetlands. However, the projects should prove to be beneficial to the wetland ecosystems since they are designed to enhance the area and volume of the existing wetlands. This will provide more of each functional value currently provided by the existing wetlands. Applications for permits from the U.S. Army Corps of Engineer's for construction activity in the wetland areas will be made.

2. Threatened or Endangered Species

According to the Indiana Department of Natural Resources, no threatened or endangered species of plants or animals are known to exist in the proposed project locations.

3. Operation and Maintenance Activities

The future O&M dredging of the wetland basins may cause temporary damage to aquatic benthic (ditch or lake bottom) community. However, based on several studies done on other dredging projects the negative impacts are short lived with the benthic community recovering completely within a few seasons. The impacts may be mitigated by closing the slide gate and forcing the water leaving the sedimentation basins during the dredging process into the constructed wetlands. Sediment escaping the basin will be settled out in the wetlands.

Given the heavy sedimentation of the subject areas, the construction or operations and maintenance projects will not be disturbing a high quality benthic community or a sand/gravel substrate.

G. Land Rights

The type of property rights acquisitions for the construction or long term operation of the designed structures, whether as easements, lease arrangements or outright purchases, has not been determined by the Lake Manitou Association, Inc. This summary will need to be revised once final property acquisition has been completed.

H. 0 & M Considerations That Have Affected Design

1. Stop Log Openings

The weir has been designed with the stop log outlet structures in them to facilitate the complete draining of the basins for O&M purposes a well as for access for wildlife habitat enhancement projects in the future. Wood stop logs were specified in these openings rather than a synthetic material so, if the logs proved difficult to remove the operator has the option of using a chain saw to remove the planks.

The use of stop logs was preferred over a gate, since it may be as long as ten years between operating events. The likelihood of a gate becoming inoperable over this period of time in the given environment was very high. Stop logs are simple and long lived.

2. Steel Sheet Piling

This material was chosen over an earthen dam for several reasons. The optimal design for the structures were low head weirs rather than a dam with a single point discharge outlet structure. This allowed more even distribution of the residence time of water moving through the constructed wetland systems.

Based upon the soil borings, suitable materials for an earthen dam are not readily available on-site. Additionally, because of the instability of the soils, the dam would have to be armored with rip-rap for its entire length. This considerably increases the initial construction costs, and the cost of operating and maintaining the structures.

The purpose of Structures No. 1 and No. 2 is to establish normal pool water levels and detention of peak stormwater flows within the wetland area. Baffles are designed across the existing channel to distribute peak flows throughout the flooded wetland.

Structure No. 2 consists of a low earth dam and a P.V.C. sheet piling weir. The earth dam is protected from erosion by gabions and riprap at the weir. The P.V.C. weir is designed with a timber stop log draw down structure. Baffles consist of earth embankments. Materials were chosen for economy and ease of construction. Structure No. 1 consists of driven steel sheet pilings with steel grating for dissipating energy.

I. Engineer's Estimated Costs For The Project Construction Phase

The following **Table No. I - 1** provides cost estimates for both the construction portion and the engineering and inspection services to be provided during the project construction phase.

TABLE NO. I-1
CONSTRUCTION PHASE I COST ESTIMATES

Item/Task	No. of Units	Cost/Unit	Total Costs
1. Structure #2	1 LS	$18,100	$18,100
2. Baffle #1	1 LS	$ 3,250	$ 3,250
3. Baffle #2	1 LS	$ 3,250	$ 3,250
4. Baffle #3	1 LS	$ 3,250	$ 3,250
5. Baffle #4	1 LS	$ 1,920	$ 1,920
6. Sediment Basin #1	1 LS	$13,600	$13,600
7. Sediment Basin #2	1 LS	$ 6,750	$ 6,750
8. Draw Down Structure	1 LS	$ 1,250	$ 1,250
9. Wetland Plants/Seeding	1 LS	$ 8,500	$ 8,500
SUBTOTAL			**$59,870**
10. Mobilization	1 L.S.	$ 5,987	$ 5,987
TOTAL CONSTRUCTION COSTS			**$65,857**
11. Construction Engineering			$ 5,000
12. Inspection			$ 8,000
13. Administration			$ 4,000
TOTAL CONSTRUCTION PHASE COSTS			**$82,857**

TABLE NO. I-2
CONSTRUCTION PHASE II COST ESTIMATES

Item/Task	No. of Units	Cost/Unit	Total Costs
1. Structure #1	1 LS	$49,920	$49,920
2. Planting	1 LS	$ 9,000	$ 9,000
SUBTOTAL			**$58,920**
3. Mobilization	1 L.S.	$ 4,016	$ 5,892
TOTAL CONSTRUCTION COSTS			**$64,812**
4. Construction Engineering			$ 5,000
5. Inspection			$ 8,000
6. Administration			$ 4,000
TOTAL CONSTRUCTION PHASE COSTS			**$81,812**

SECTION II

INSPECTION PLAN

A. Overall Description of Project

1. Project Location

The Lake Manitou, Graham Ditch Wetland Project is located approximately 2 miles east of the City of Rochester on the east side of Lake Manitou in Fulton County, Indiana. The project is specifically located on the Graham Ditch south of State Road 14, west of County Road 500 E. and north of County Road 50 S. The project and affected portion of Graham Ditch is approximately 3700 feet in length upstream from Structure #1.

2. Project Description

The project involves constructing two water control structures in the Graham Ditch. One structure will be an earthen embankment incorporating a piling water control structure with rip rap and gabion spillways. The second structure will be a steel sheet piling with steel grating used to dissipate energy in the overflowing water. The purpose of the structures are to re-establish normal pool and flood detention area within an existing channelized wetland. The structures will provide approximately 4 acres of normal pool area and 32 acres of flood detention pool area. Earth embankment baffles will also be constructed across the ditch channel upstream of Structure #2 to divert flood waters into the wetland flood detention area. Sediment basins will be constructed to assist with normal flow sediment removal in the existing ditch channel. The traps will also collect larger sediment during peak flows and help maintain the integrity of the wetland. All embankments and areas disturbed during construction will be seeded or planted with species suitable to the wetland area.

3. Inspector's Responsibility

The responsibility of the Inspector is to ensure the Contractor complies with the requirements of the project plans and specifications (Contract Documents). Specifically, that the materials furnished and the work installed meet the intent of the project plans and specifications.

B. Items of Work to be Inspected

The primary items of work to be inspected include the following items:

1. Structure #1 - Sheet Piling and Grating

- Ensure horizontal and vertical staking of sheet piling
- Installation of piling to ensure correct alignment and elevations

- Confirm proper location of grating

2. **Structure#2 - Sheet Piling, Draw-Down Structures, Geotextile Fabric, Gabions and Rip Rap**

   - Horizontal and vertical staking of sheet piling and draw-down structures.
   - Installation of piling and draw-down structures to ensure correct alignment and elevations.
   - Construction of draw-down structure to ensure water control structures do not leak.
   - Confirm proper location and elevation of geotextile fabric, gabions and rip rap.
   - Check on site bench marks.

3. **Earth Embankment Construction**

   - Ensure horizontal and vertical staking of Structure #2 embankment and baffles.
   - Ensure Contractor provides the specified compaction testing as the berms are being constructed.
   - Verify that the Contractor is following proper erosion control procedures during construction of the berms.
   - Confirm that the berms are properly seeded after construction.
   - Verify the Contractor is conducting soil density testing in accordance with the requirements listed in the Project Manual.

4. **Erosion Control**

   - Ensure that erosion control practices are installed and utilized as set forth in the Indiana Handbook for Erosion Control in Developing Areas.
   - Ensure that all areas disturbed by construction activities have been restored and planted in accordance with either Specification Sections 14 or 15.

5. **Other Items**

   - If damaged, all road surfaces used for equipment and machinery access are

restored to original condition.

- Prior to final completion, the Contractor has adequately cleaned up the construction site.

With the exception of the installation of the steel piling, the inspection of the above items may be intermittent. Inspection of the installation of the sheet piling should be continuous to verify the piling is installed to the correct alignment and elevations.

C. Project Layout and Staking

The Contractor shall provide primary location staking for all structures, baffles and sediment basins. The Contractor shall be responsible for establishing on site bench marks and setting grade for structures, baffles and sediment basins.

The project was designed using an aerial topographic map as a base map. Preliminary horizontal control for construction was not established in the field. Existing property lines and topographic features must be used as reference for primary location staking. It is essential that the Owner's representative be present during primary location staking.

The following locations are offered for general horizontal layout locations:

- **Structure #1** - Locate east of Hazel Winterrowd west property line.

- **Sediment Basin #2** - Locate north of Baffle #4 between the north end of the baffle and the north bank of the wetland area.

- **Structure #2** - Locate between the points of high ground as indicated on the topography map.

- **Baffle #3** - Locate on channel approximately 450 ft. upstream of Structure #2.

- **Baffle #2** - Locate on channel approximately 400 ft. upstream from Baffle #3.

- **Baffle #1** - Locate on channel approximately 350 ft. upstream from Baffle #2.

D. Maintenance and Development of Record Drawing

It is the responsibility of the Contractor to develop and maintain Record ("As-Built") Drawings for the project. However, the Inspector should maintain his own set in clear readable order on the project site for the inspection by any interested party.

The record drawings shall show all final elevations and dimensions, sizes and depths for buried sheets, members, structures, and all other information as necessary to constitute as-built records. These documents shall be kept daily by the Contractor and be made available to the Inspector and routinely checked by the Inspector for completeness and accuracy based on the Inspector's daily records and notes. It will be the Contractor's responsibility to furnish any and all information lost due to the Inspector's loss of these record drawings and vis-a-vis. In addition to other Contract requirements, retainage will be partially based on the Contractor's and Inspector's ability to maintain good as-built records, as determined by the Owner. Upon completion of the project these record "as-built" drawings together with any other annotated supplemental plans, drawings, sketches, etc. shall be delivered to the Owner for his final review and approval. If disapproved, they will be returned to the Contractor for corrections, as necessary.

E. List of Inspector's Equipment

All persons providing construction inspection services shall have available the following minimum list of equipment:

- Fiberglass of steel measuring tape (100').
- Notebook and/or daily inspection forms for recording Contractor's activities and progress. See **Appendix A.**
- Hand-held calculator.
- A two foot (minimum) level.
- Two (2) sets of Plans and Specifications - one set designated for recording as-built information.
- Access to a surveying level, tripod, and measurement rod in good working condition. Typically this can be supplied by the Contractor.

F. Recommended Qualifications of Inspectors

The inspector shall have the following minimum qualifications:

- Previous experience in inspecting civil engineering projects, in particular, the construction of soil embankments, sheet piling installation and general carpentry.
- Experience in the establishment of vertical and horizontal control or access to a qualified surveyor.
- Experience in the inspection and/or installation of erosion control materials.
- Above all, the Inspector must be completely familiar with the requirements of the Contract Documents.

SECTION III

OPERATION AND MAINTENANCE PLAN

A. Description of Operational Procedures and Maintenance Activities

The following are recommended methods and strategies for operating and maintaining the hydraulic control structures and sediment control basins designed for the lake enhancement project. The hydraulic control structures establish the water level of the constructed wetlands. The sediment control basins have been designed to require minimum operator attention and minimize long term maintenance.

1. Operational Procedures

The intent of the design of structures no. 1 and no. 2 is to reestablish normal pool water levels and to detain high storm water runoff flows in the wetland. Detention in the wetland reduces flow velocity through the original channel and allows for a reduction of suspended solids transported by storm runoff. Detention in the wetland also increases contact time between storm water and wetland vegetation, which contributes to a reduction of nutrients transported by high flows.

2. Maintenance Activities

The primary maintenance activities to be performed are as follows:

a) Inspect earth embankments for settlement, erosion damage, and animal damage.

b) Inspect drawdown structures for damage, leakage, or vandalism.

c) Inspect weirs for damage or obstructions such as tree limbs. Remove all obstructions from weirs and spillways.

d) Inspect riprap spillways for excessive stone displacement or erosion.

e) Inspect grating for excessive blockage by debris.

f) Periodically remove sediment from basins.

B. Projected Maintenance Schedule

1. Inspection of Rip-rap and Erosion Control Measures

All exposed rip-rap should be inspected for stability on an annual basis. Any riprap that is misplaced or that has been moved should be replaced (if possible with heavier stones). Where erosion has occurred, protective measures should be installed to minimize further erosion.

2. Periodic Removal of Sediment from Basins

a) Timing of Periodic Maintenance

The USDA Soil Conservation Service (SCS) recommends that a sedimentation basin have the trapped sediment removed when the basin has lost **50%** of its design volume.

The estimated frequency of periodic maintenance is based on statistical modeling calculations of when the sediment control basins will lose half of their designed volume from trapped sediments. These models were developed by the SCS based on empirical data from experimental sedimentation basins.

Various assumptions on variable conditions in the Lake Manitou watershed had to be made to estimate the sediment removal frequency. The sediment removal frequency and the assumptions used in the sedimentation rate calculations are provided in the following **Table No. III-1.** Sediment basin No. 2 is projected to be 50 percent filled in one (1) year.

All estimated values represent existing conditions. The frequency can be reduced by the implementation of upstream watershed improvements. However, the use of existing conditions as a conservative "worst expected case" condition allows the Owner to plan manpower and budget conservatively. The actual time it takes for the basins to become 50% percent full of sediment may vary. However, for project planning and budgeting purposes it is recommended that the Lake Manitou Association use the Engineer's projected periodic maintenance estimate.

b) Sediment Removal Methods

There are three main methods of sediment removal: hydraulic dredging, drag-line dredging, and land based excavating with earth moving equipment. Any of which will remove the sediment. Due to the relatively small size of the basins, the use of land based equipment would be the most probable method. The Engineer suggests that the Owner solicit bids from qualified contractors to perform the sediment removal and let the bidding process dictate which is the most efficient method to use. The contractor should submit a Plan of Operation, detailing the specifics of their proposed operation, with their bid to perform the sediment removal and disposal.

TABLE NO. III-1
SEDIMENT REMOVAL FREQUENCY
SEDIMENTATION BASIN NO. 2

Parameter	Value	Source
Crop Land Soil Loss	5 tons/acre/year	Fulton Co. SWCD
Acres Cropped Land	4518 Acres	Fulton Co. SWCD
Sediment Yield Coefficient	0.2	SCS Area Office
Sediment Yield to Basin	4518 tons/year	JFN Calculation
Sediment Densfty	100 lbs/ft3	NEH-3
Annual Sediment Load	2.1 acre feet/year	Fulton Co. SWCD
Volume of Basin	2.8 acre feet	TR-20
Annual Sediment Accumulation	4518 tons/year	JFN Calculation
No. of Years to Fill Basin 50%	**1 Year**	**JFN Calculation**

C. Disposal of Dredged Spoil

1. Permitting for Dredging and Disposal of Spoil

Dredging operations will require a permit from the U.S. Army Corps of Engineers, since Lake Manitou is considered to be waters of the United States' under the Clean Water Act. This permit is required even when dredge spoil is disposed of on an upland site.

A permit should not be required from the Indiana Department of Environmental Management (IDEM) for land disposal of dredge spoil. Most lake sediments in rural areas have relatively low concentrations of substances regulated as hazardous waste. Therefore, the material can be disposed of in almost any upland site without acquiring an IDEM permit.

However, if hydraulic dredging is used the method of disposal for dredged sediments involves the construction of a temporary diked basin, on an upland site, to pump the slurry to. The temporary basin has a sluice gate with a pipe to dewater the basin after the sediments have settled out of the water column. The dewatering outlet can either be a pipe delivering water back to a ditch or the lake, or, the water can be discharged on the ground surface and allowed to drain back into a ditch or the lake via overland flow. Overland return flow has two advantages over piped return flow:

a) Overland return flow allowed to drain over vegetated land is further filtered of sediments prior to its discharge back into the Lake.

b) The discharge of return flows from a point source (pipe outfall) may require a temporary NPDES permit to discharge from the IDEM. There could be strict suspended solids limits in such a permit that would require more expensive treatment of the return water. This could involve either: applying a flocculent to the basin to precipitate (coagulate and settle) sediments from the basin water column; or, sizing the basin and timing the operation of the dredge such that the water is allowed longer residence time in the basin for increased sediment fallout. Increased basin sizing could make a temporary basin difficult to site and require a much longer pumping distance. However, if pipe flow is necessary, it will require a NPDES permit.

2. Disposal of Dredge Spoils

The availability and identification of disposal sites may ultimately dictate the method of dredging that will be required. If hydraulic dredging is to be performed a dewatering/disposal site must be designed with the appropriate size, containment and outlet structures. Preferably sediments should be disposed outside the watershed, or at least in an application protected from erosion and transport back into the lake. Sediment testing may be required if dredged material is used as topsoil or other types of soil amendments.

Careful consideration must be given to disposal of excavated materials to minimize costs. An upland site is preferred. Disposal of hydraulically dredged material requires a dewatering and disposal site such as construction of a temporary basin(s), a dry pond or a water and sediment control basin. Disposal sites should be rotated, if possible, to minimize the wear and tear on roads, if trucked, or to allow adequate retention time if pumped.

Potentially, the dewatered material removed from the lake will be in high demand locally as topsoil or a soil amendment by persons capable of self hauling.

The disposal of dredged material can account for half of the total cost of sediment removal operations. One option would be to leave the dredge spoil piled at an accessible site available to self-haulers for a giveaway program. The other option would be to have the contract documents require that the contractor is responsible for removal and disposal of all spoil.

D. Estimated O & M Costs per Year

Comparing costs are very difficult because of the highly variable disposal conditions that may be available. For example the cost of siting and constructing a dewatering facility for hydraulically dredged sediments plus any cost in removing the material after dewatering (ff a give away program is not implemented) may be more or less expensive than loading, transporting, and disposing of sediments dredged via earth moving equipment or drag-lining. These costs are highly variable from Contractor to Contractor.

It is recommended that the owner advertise for bids from qualified, responsible contractors without specifying the precise type of equipment to be used. The bid documents may specify that the contractor is responsible for obtaining disposal sites and arranging the timing and operation of the sediment removal.

It is recommended that the Lake Manitou Association retain an engineer/consultant to assist in the disposal site selection, obtain permits, and to develop the contract documents and specifications for the sediment removal operation.

The following **Table No. III-3** present preliminary cost estimates for removing and disposing of sediment from the basins. The estimate is based upon using land based earth moving equipment and a two (2) mile round trip to the disposal site.

The estimated cost for Sedimentation Basin No. 2 is $14,185. If the basin is dredged every year, the annual cost would be $14,185, in 1996 dollars.

TABLE NO. III-3
SEDIMENT REMOVAL AND DISPOSAL COST ESTIMATE
SEDIMENTATION BASIN NO. 2

Activity	No. of Units	Cost/Unit	Total
Equipment Mobilization	1 LS	$5,000 LS	$ 5,000
Sediment Removal	970 CY	$6.00/CY	$ 5,820
Transportation and Disposal	970 CY	$4.50/CY	$ 4,365
Total			$ 14,185

SECTION IV

POST CONSTRUCTION MONITORING PLAN

A. General

The post construction monitoring program for the Graham Ditch Wetland Project involves monitoring the effectiveness of the wetlands and sedimentation basins.

The post construction monitoring program should be integrated with the operation and maintenance activities discussed in **Section III.**

The following monitoring plan centers on monitoring the effectiveness of the wetlands and sediment basins in removing sediments and the nutrient phosphorus. Phosphorous is normally the limiting nutrient in aquatic systems. A secondary component of the monitoring plan is to inspect structures and monitor the succession of the wetland system.

A plan to monitor the success of lake enhancement projects must contain four key elements:

1) Qualified personnel to perform the monitoring;

2) Clearly defined monitoring objectives with a specific set of monitoring parameters;

3) A monitoring schedule;

4) A reporting format.

B. Qualified Personnel

Personnel monitoring the success of the wetlands and sedimentation basins after construction is complete should have the following qualifications:

- General knowledge of wetlands and wetland ecological functions.
- Familiarity with the design objectives to be achieved by the constructed wetlands and sedimentation basins.
- Familiarity with identification of wetland plant species, herbaceous vegetation, shrubs and trees.
- General familiarity with the watershed and soil types.

C. Monitoring Objectives And Recommended Inspection Parameters

The purpose of this monitoring program is to verify that the constructed wetlands and sedimentation basin are performing the water quality improvement functions they were designed to provide.

1. Visual Inspection

The visual inspection component of the monitoring program will involve three major components:

a. Inspection of the structural integrity of the sedimentation basin and hydraulic control structures (See Section III).

b. Inspection and assessment of the vegetative community in the wetlands.

c. Determination of the silt depth in the sedimentation basin and wetlands.

For both the sedimentation basin and the hydraulic control structures a visual inspection of the **structural integrity** will be necessary. The project area will need to be inspected for the following:

- Human activity and vandalism, such as riding horses and off-road vehicles on embankments, destruction of outlet structures, etc.
- Animal activity, such as groundhog, beaver or muskrat burrowing.
- Erosion.
- Tampering with the stop logs on the hydraulic control structures.

Prompt reporting to Fulton County Sheriff or conservation law enforcement personnel of any illegal activity impairing the performance or integrity of the project area.

The wetlands will need to be inspected to **assess the vegetative community** which is an important indicator of their health and therefore their efficiency in removing nutrients. At least one on-site consultation will be held between a wetland scientist ant the landscape contractor prior to the implementation of the planting plan. Monitoring of the wetland will commence after one complete growing season has passed and continue for three years. Site visits will be made primarily between July 15 and September 15. The monitoring plan will observe the following guidelines:

a. A total of four permanently marked quadrats will be established in the treatment area. Two quadrats will be established in each wetland: one above the ordinary water line and one in approximately 2 feet of water. Percent cover will be estimated for all species encountered. Water depth will also be noted for each quadrat. Photographs will be taken of each quadrat.

b. Two permanent photographic stations will be set up at key vantage points to provide a panoramic visual documentation of wetland development around each wetland.

c. Wildlife use will be noted through informal surveys.

d. A general survey of the wetland will be made in order to note the presence of planted and volunteer species which were not present in the sample quadrats. In order to monitor the their effectiveness a set of monitoring parameters must be defined. In general the monitoring would involve visual inspection and chemical testing.

Finally, the sedimentation basin and the constructed wetlands should be monitored to **determine the amount of silt build up**. The depth of silt in each structure should be recorded to assess the rate of silt accumulation.

2. Chemical Testing:

The following tests should be conducted to determine the performance of the constructed wetlands and sedimentation basins.

- Total Phosphorus (TP)
- Total Suspended Solids

Many other parameters may be routinely measured in monitoring programs where ample funding and expertise are available. Most of these parameters are measured for reasons more academic than utilitarian. The 1988 EPA Lake and Reservoir Restoration Guidance Manual has a section on post monitoring of lake restoration projects. It is suitable for monitoring overall lake water quality improvement resulting from implementation of restoration practices. The Guidance Manual contains a table listing a sampling protocol for overall lake monitoring. If information on additional parameters are deemed necessary, J. F. New and Associates, Inc. staff are available to work with the Lake Association to redefine monitoring objectives.

D. Monitoring Schedule and Sampling Locations

The monitoring should be performed on a seasonal basis, with consideration given to interpreting the results of the chemical parameters. In different seasons, natural surface waters are expected to exhibit different chemical characteristics. This should be kept in mind

when results are being analyzed. Therefore, results should not be compared between different seasons.

Visual inspection of the structural integrity of the project site should occur on a routine basis and as often as possible.

Chemical samples should be taken ahead of the sedimentation basins and from the effluent of

the constructed wetland. The sample should be taken from water representative of the average influent and either the average effluent or the well mixed water in the downstream portion of the constructed wetland.

Following is the recommended annual monitoring schedule and the parameters to monitor:

TABLE IV-1
MONITORING SCHEDULE

Monitoring Parameter	Spring (April)	Summer (July)	Fall/Winter (Nov.-Feb.)
Vegetation Mapping		x	
Structural Inspection	x	x	x
Total Phosphorus	x	x	x
Total Suspended Solids	x	x	x

The monitoring program should be implemented as soon as the wetlands are filled to capacity and fully operational.

While the wetlands are expected to begin performing their intended purpose immediately, in-lake recycling of nutrients from main lake sediments will keep the phosphorus levels in the main lake water column high for several more years.

E. Sample Collection/Analysis

Within 24 hours of the end of approximately a one and one half (1 1/2) inch rain event, when sediment is being transported from the watershed to the sedimentation basins.

Water can be analyzed for TP and TSS at relatively reasonable rates. For example, TP samples analyzed to detection limits of one tenth of a part per billion (. 1 ug/1) are usually performed for $28 per sample. Total Suspended Solids (TSS), measured in parts per million, can be analyzed at $14 per sample. Therefore, the annual cost for laboratory testing would be approximately $300, including sample shipping costs.

Water quality entering the first sedimentation basin should be compared to the water quality leaving the last hydraulic control structure.

F. Reporting Format

The reporting of field measurements and observations should be done on standard forms made up by the person designated responsible for the monitoring and reporting of results.

Care should be taken so that data from monitoring the constructed wetlands effectiveness can be used in a comparison to overall lake water quality postmonitoring results. An annual report based on the results of each year's inspection will be filed with the Corps of Engineers each monitoring year. The report will include:

1. Tables listing percent frequency and estimated percent aerial cover for all species encountered in each quadrat.

2. Photographs from each photographic station. A discussion of the developing community structure and diversity of the restored wetland.

3. A description of the hydrology within each planting zone and a determination if that hydrology level is consistent with the mitigation plan.

4. A discussion of observed wildlife usage.

5. A description of remedial plantings (if any) and reasons for unacceptable mortality.

6. Comparison of previous year(s) data with current year to document trends toward a more mature and diverse wetland system.

All field data sheets should be copied and stored in a three ring binder for annual compilation and analysis. Results of each monitoring should be tabulated so that comparisons between monitoring inspections are presented in only a few tables.

Results from the testing labs also need to be tabulated and included as part of the reporting format.

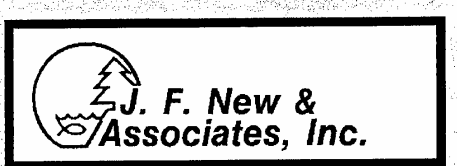
SUPPLEMENTAL SPECIFICATIONS TO REVISED DESIGN FOR STRUCTURE #1

LAKE MANITOU

ROCHESTER, INDIANA

REVISED PER IDNR COMMENTS
DECEMBER, 1997

J. F. NEW & ASSOCIATES, INC.
Environmental Engineers/Biologists/Planners/Consultants
Walkerton/Indianapolis, Indiana



SECTION 02410

STEEL SHEET PILING

2.1 Material
Bethlehem Steel Sheet Piling is furnished to the requirements of the Standard Specification for Steel Sheet Piling of the American Society for Testing and materials, ASTM Designation A328, ASTM A572 Grade 50 or ASTM A690.

a. Furnish Bethlehem Steel Sheet Piling or equivalent.

2.2 Number of Tests
Two tension tests shall be made from each sheet. In addition, two interlock tests shall be made from each heat for sections PSA23, PS27.5 and PS31.

2.3 Tolerances
When using steel sheet piling, it is necessary to make allowances for deviations from theoretical exactness. The degree of precision obtainable in the production of steel sheet piling is limited by the basic character of the rolling processes and normal limitations of mill equipment. Interlocks should be continuous and reasonably free-sliding when threaded. Care must be taken during installation to assure that each pair of sheets is being set at the desired driving dimension. All steel sheet piling and fabricated connections have an allowable weight variation of +/- 2-1/2% and are invoiced on theoretical weight. Length tolerance is -0 in., +5 in.

2.4 Fabricated Connections
Unless otherwise specified, all connections will be fabricated with angles, channels or bent plates, ASTM A36, and with high-strength bolts. ASTM A690 connections will be furnished with angles or plates made from ASTM A588 steel and with ASTM A325 Type 3 blots.

2.5 Lengths
Sheet piling sections shall be rolled and cut to lengths indicated on drawings.

2.6 Splicing
Splicing of Z-piling is not allowed.

2.7 Handling Holes
Unless otherwise specified, all plain piling sections shipped directly from the mill shall be provided with standard handling holes in the centerline of the web. The standard handling hole shall be a 2-9/16-in. diameter hole approximately 6 in. from the end.

a. Z-Piling - one hole in each end.

2.8 Pairing
Z-Piling in lengths up to 60 ft. can be supplied in pairs. The pairs will be shipped without welding or crimping which will insure maximum flexibility when setting a wall.

3.1 Driving
Assembly of panels of steel sheet piling before driving is suggested. This facilitates driving, maintains piling verticality, and makes it possible to obtain the nominal width of piling sections. Z-piles should be driven with the ball edge leading. In addition, care should be taken - in the selection of connections and in planning for closed structures (cofferdams, etc.) - to provide for the proper sequence of driving. For normal interlocking, alternate Z-piles must be reversed end for end.

SECTION 02830

WETLAND SEEDING

PART 1 - GENERAL INFORMATION

1.1 DESCRIPTION

A. This work shall consist of furnishing, delivering, and seeding wetland areas in accordance with this Specification and in conformance with the Drawings, or as directed by the Engineer.

1.2 GUARANTEE

A. At least 50% of all individual species planted shall be present as live plants at the end of the first growing season. Aerial coverage of the seeded areas will be at least 70% with no large bare spots. No more that 10% (by aerial cover) of the seeded area will be dominated by perennial weedy species. If these standards are not met, the Contractor will be responsible for supplemental seedings as approved by the Engineer. Losses due to animal depredation, extremes in weather or precipitation, or lack of water control shall not be covered under this warranty.

1.3 QUALITY INSURANCE

A. The Contractor shall use qualified workmen who are experienced with commercial landscaping work or preferably have previously planted wetland plant seeds.

PART 2 - PRODUCTS

2.1 MATERIALS REQUIREMENTS

A. Delivery of seed shall be timed to coordinate closely with the planting time. If seed needs to be held for more than 1 day, it shall be stored in a cool, dry place until such a time as it can be used. In no case shall seed be held over from one year to the next. All seed used shall be scarified and/or cold/moist stratified as recommended for each particular species specified.

2.2 ACCEPTABLE PLANTS

A. The seed species and seeding rates shall be as shown on the Drawings.

B. Where the Drawings and Specifications call for tree and shrub wetland plantings and/or sedge meadow with flowers mix, a nurse crop shall be planted with the species and rates as shown on the Drawings.

PART 3 - CONSTRUCTION REQUIREMENTS

3.1 PLANTING INSTRUCTIONS

A. Ground preparation is not required for seeding in saturated disturbed soils. Seed shall be broadcast evenly over planting area at rates prescribed on plans. No cultipacting is required. Acceptable season shall be October 1 thru July 1.

PART 4 - PAYMENT

4.1 METHOD OF MEASUREMENT

A. Seeding will be measured by the square yard.

4.2 BASIS OF PAYMENT

A. There will be no separate payment for the work described in this Section. The cost of this work is to be included by the Contractor in the total cost of the contract.

SECTION 02850

EMERGENT WETLAND PLANTING

PART 1 - GENERAL INFORMATION

1.1 WORK INCLUDED

A. This Section covers emergent wetland plant specifications, species of plants, method for planting and storage.

B. This work shall consist of furnishing, delivering and planting wetland plants in accordance with this Specification and in reasonably close conformance with the Drawings or as directed. Wetland plants, for purposes of this Specification are defined as those plants which for greater than 66% of the time are found in areas where the soils are saturated for a significant portion of the growing season.

1.2 GUARANTEE

A. At least 50% of all individual plants and 75% of all species planted shall be present as live individual plants at the end of the first growing season after planting. If these standards are not met, the Contractor will be responsible for supplemental plantings as approved by the Engineer. Losses due to animal depredation, extremes in weather or precipitation, or lack of water control shall not be covered under this warranty.

1.3 QUALITY INSURANCE

A. The Contractor shall use qualified workmen who are experienced with commercial landscaping work or preferably have previously planted wetland plants.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PLANTS

A. The emergent wetland plants that shall be used shall be as shown on the Drawings.

B. The number of each species to be planted shall be as shown the Drawings.

2.3 CONDITION OF PLANTS PRIOR TO PLANTING

A. All plants shall be delivered free of diseases and molds with the roots kept in a moist condition. Roots must not be allowed to dry out during planting. Transplants and cuttings shall be stored in a cool location and rooted plants shall be watered as needed to reduce stress before planting.

PART 3 - CONSTRUCTION REQUIREMENTS

3.1 PLANTING INSTRUCTIONS

A. Stakes shall be set to mark the planting zones and the locations reviewed with the Engineer. Plants will be planted in groups spaced as indicated on the plans, 3 plants in a group in a random pattern, not in rows, across the planting zone unless specified otherwise on the Drawings. The method for planting wetland plants into the ground will consist of inserting and rotating a trowel or dibble into the soil and inserting the plant roots into the hole created so that they are completely buried. No supplemental watering, mulching or fertilization will be required. The stakes shall be removed as directed by the Engineer.

B. Under no circumstances should planting be done when the air temperature is below freezing. Planting should be accomplished when the air temperature is greater than 40°F. Planting should be completed by August 1 to achieve the best performance.

PART 4 - PAYMENT

4.1 METHOD OF MEASUREMENT

A. Wetland plants will be measured on a per plant basis of each type specified, installed and accepted.

4.2 BASIS OF PAYMENT

A. There will be no separate payment for the work described in this Section. The cost of this work is to be included by the Contractor in the total cost of the contract.

SECTION 02880

WETLAND TREE AND SHRUB PLANTING

PART 1 - GENERAL INFORMATION

1.1 DESCRIPTION

A. This work shall consist of furnishing, delivering, and planting trees and shrubs in accordance with this Specification and in conformance with the Drawings, or as directed by the Engineer.

1.2 GUARANTEE

A. At least 50% of all individual plants and 75% of all species planted shall be present as live individual plants at the end of the first growing season after planting. If these standards are not met, the Contractor will be responsible for supplemental seedings as approved by the Engineer. Losses due to animal depredation, extremes in weather or precipitation, or lack of water control shall not be covered under this warranty.

1.3 QUALITY INSURANCE

A. The Contractor shall use qualified workmen who are experienced with commercial landscaping work or preferably have previously planted wetland plants.

PART 2 - PRODUCTS

2.1 MATERIALS REQUIREMENTS - TREES

A. The tree seedlings that shall be used shall be as shown on the Drawings.

B. The minimum caliper of each tree shall be 7/32". The minimum height of each tree shall be 10". All trees shall be dormant, bare-root stock.

C. The number of each tree species to be planted shall be as shown the Drawings.

2.2 MATERIALS REQUIREMENTS - SHRUBS

A. The shrub seedlings that shall be used shall be as shown on the Drawings.

B. The minimum caliper of each shrub shall be 6/32". The minimum height of each shrub shall be 10". All shrubs shall be dormant, bare-root stock.

C. The number of each shrub species to be planted shall be as shown the Drawings.

PART 3 - CONSTRUCTION REQUIREMENTS

3.1 PLANTING INSTRUCTIONS

A. Planting zones shall be staked in the field and the locations reviewed with the Engineer. Bare rooted plants shall be stored in paper bags with moist sphagnum or paper packed around their roots, and with the roots wrapped in plastic to retain moisture, or equivalent. Storage of these plants will be in a cool dark place until the day they are to be planted. The roots shall not be allowed to dry out before they are planted. Bare root woody plants may be planted as permitted by ground thawing before they break dormancy in the spring, or they may be held in cold storage to keep them dormant and planted up to June 1. Later plantings may be made upon approval under extenuating circumstances. Planting, and backfilling shall be accomplished by placing the plant in the plant hole at the proper position for depth, alignment, final grade of the surrounding ground level, and vertical position of the trunk. The planting procedure shall be performed in such a manner that the top of the root collar of the plant is no more than .25" below the ground surface. No supplemental watering, mulching or fertilization will be required. Seedlings shall be planted in the zones as staked in the field. Species shall be planted at spacing indicated on plans. Species shall be planted in a random order, not in rows, but in a natural appearing pattern within the proper planting zones. In situations where aggressive weeds threaten to severely compete with tree seedlings, spot herbicide applications may be applied as approved in order to reduce weed competition. Buttonbush are to be planted in 4" below to 4" above normal pool elevation. All other tree and shrub species are to be planted from normal pool to 12" to 18" above normal pool elevation.

B. Species shall be selected from the list as shown above. If necessary as few as 70% of the species listed may be planted, however the total number of plants installed shall be as shown on the Drawings.

PART 4 - PAYMENT

4.1 METHOD OF MEASUREMENT

A. Tree and shrub seedlings will be measured on a per plant basis of each type specified, installed, and accepted.

4.2 BASIS OF PAYMENT

A. There will be no separate payment for the work described in this Section. The cost of this work is to be included by the Contractor in the total cost of the contract.

SECTION 05100

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work under this Section consists of providing all labor, materials and equipment necessary or required for the complete fabrication and erection of all structural steel as detailed on the Structural Drawings and as specified herein.

B. Other Work furnished: Anchor bolts and other connection components.

1.2 QUALITY ASSURANCE

A. The latest editions of the following standard specifications shall govern the fabrication and erection of the structural steel, except as modified by the design drawings or this specification:

1. AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings".
2. AISC: Code of Standard Practice for Steel Buildings and Bridges", except that Section 4.2.1 is specifically excluded.
3. AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
4. AWS "Structural Welding Code D1.1".
5. Steel Structures Painting Council Specifications SSPC.

B. All welders in both shop and field shall be certified under AWS "Standard Qualification Procedure" for the type or types of welding being performed and shall have been continuously engaged in such welding.

C. Fabricator and erector shall have continuous business operation for at least 5 years and by evidence of past projects indicate capability of conducting work of a similar nature; have sufficient well maintained equipment to perform the work; maintain an adequate stockpile of materials; qualified labor to fabricate or erect without delay the materials required for this project.

thus (50), high strength steel shall conform to the requirements of ASTM A572.

B. Structural steel tubing: ASTM A500, Grade B, Fy = 46 ksi.

C. Structural steel pipe: ASTM A53, Type E or S, Grade B, Fy = 35 ksi or ASTM A501, Fy = 36 ksi.

D. Connection bolts: ASTM A325N (bearing bolts).

E. Anchor bolts: ASTM A36.

F. Drilled-in anchors (expansion bolts): KWIK-Bolt stud anchor by Hilti Fastening Systems (or approved equal).

G. Welding rods: AWS E70XX for A36 and Grade 50 steel.

H. Headed studs (used as anchor studs or as shear connectors): ASTM A108.

KSM Fastening Systems, Omark Industries
Nelson Stud Welding, TRW Nelson Division
Blue Arc Welding Studs, Erico Products

I. Deformed bar anchors: ASTM A496.

KSM Fastening Systems, Omark Industries
Nelson Stud Welding, TRW Nelson Division

The use of manually welded anchors, rods, bars, straps, or reinforcing bars is <u>not</u> acceptable as a substitute for headed studs or deformed bar anchors.

J. Malleable Iron Wedge Inserts: Hohman-Barnard (or approved equal).

2.2 FABRICATION

A. Fabricate structural steel in accordance with the AISC "Specifications for Design, Fabrication, and Erection of Structural Steel for Buildings" with the modifications and additional requirements specified in this Section.

B. Shop connections shall be welded or bolted with A325 bolts.

C. Use only low hydrogen electric arc electrodes. Manual welding shall be accomplished with shielded arc electrodes of E70XX series or the strength equivalent of flux cored arc weld. Submerged arc process welding shall be grade SAW-2.

1.3 SUBMITTALS

A. SHOP DRAWINGS

1. Shop Drawings shall be submitted to the Engineer for review. Shop Drawings shall include erection plans and framing elevations, all shop and erection details including copes, connections,threaded fasteners, and welds. No fabrication shall begin until shop drawings have been reviewed.
2. Provide setting drawings, templates and directions for installation of anchor bolts and other devices.

B. CERTIFICATIONS

1. Provide certification for all welders used in field and shop work.

C. TEST REPORTS

1. Submit all test reports regarding welding, bolting, and headed studs per Section 3.03.

1.4 PRODUCT HANDLING

A. Exercise care in handling, storing and erection of structural steel to avoid damage to pieces, welds, joints and paint. Secure pieces against displacement in transit.

B. Structural steel members which are stored at the job site shall be stored above ground on platforms, skids or other supports. Protect with weatherproof cover held in place.

C. Clean members which have become soiled before erecting.

D. Anchor bolts and other anchorage devices which are embedded in cast-in-place concrete shall be delivered to the project site in time to be installed before the start of concrete operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Shapes, Bars and Plates: ASTM A36 unless noted otherwise on the Structural Drawings. High strength steel is designated on the Structural Drawings by using the yield point strength parenthetically as a suffix,

D. Connections:

1. Unless otherwise noted, beam connections shall be simple connections.
2. The steel supplier shall design the connections for at least the reactions indicated on the framing plans, but never less than 50% of the total allowable uniform load on the span.
3. Connection angles shall be 5/16" in thickness (Minimum).
4. Minimum connection strength shall not be less than that of two 3/4" diameter A325 bolts.
5. Beam connections shall consist of double web angles unless detailed otherwise on the drawings.

E. Welds shall be tested as outlined in Section 3.03. The correction of faulty welds shall be in accordance with AWS "Structural Welding Code D1.1".

F. Steel members of different grades but of the same size and length shall be marked and detailed to prevent misplace- ment during erection. Varying connection gages between grades of steel is an acceptable means of prevention.

2.3 SHOP PAINTING

A. Shop paint all structural steel except the following:

1. Contact surfaces in connections using high strength friction bolts,
2. Surfaces to be field welded,
3. Structural steel that will receive sprayed-on fire-proofing,
4. Steel encased in concrete,
5. Embedded steel items (surfaces in contact with concrete),
6. The top surface of the top flange for all composite beams,
7. Crane rails.

B. Shop Primer:

1. Material: 37-77 Tnemec Primer or equal
2. Volume solids: 55.0 ± minimum
3. Shop primer shall be compatible with the specified finish paint.

C. Surface Preparation:

1. SSPC - SP6 Commercial Blast Cleaning

D. Application:

1. Structural steel shall receive one coat of shop paint except surfaces inaccessible after assembly shall receive a second coat.
2. Dry film thickness: 2.0 mils minimum.
3. Follow coating manufacturer's printed directions.

PART 3 - EXECUTION

3.1 ERECTION

A. Erect in accordance with the AISC "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings".

B. Field connections shall be made using A325 high strength bolts, bearing type, except where welded connections are called for on the Drawings.

C. Bolt Tightening:

1. High Strength Bolts shall be "friction" type fasteners when used in the following connections.

a. Connections subjected to loosening.
b. Connections subject to fatigue due to vibrations.
c. Connections subject to stress reversals.
d. Wind bracing connections.
e. Fasteners in oversized, short or long slotted holes.

"Friction" type fasteners shall be tensioned in accordance with Table 3 of the "Specification for Structural Joints using ASTM A325 or A490 Bolts". The contact surfaces in a "friction" type connection shall be left unpainted as noted in section 2.3, A, 1.

2. High Strength bolts shall be designed as "bearing" type fasteners and tensioned in accordance with Table 3 of the "Specification for Structural Joints using ASTM A325 or A490 Bolts" when used in the following connections.

a. Connections subject to tension loads.
b. Column splices in structures over 100 feet in height.
c. Beam to Column connections in structures over 125 feet in height.

3. High strength bolts that are not covered by sections 3.1, C, 1 & 2 shall be "bearing" type fasteners. These fasteners need only be tighten to a "snug-tight" condition. "Snug-tight" shall be as defined in the "Specification for Structural Joints using ASTM A325 or A490 Bolts.

4. High strength bolts described by sections 3.01, C, 1 & 2 may be tightened by any method found acceptable by the "Specification for Structural Joints using ASTM A325 or A490 Bolts" unless otherwise noted on the drawings.

D. Set all structural steel accurately to lines and grades. Connect temporarily with sufficient high strength bolts to insure complete safety of the structure until permanent connections are made. Erection tolerances shall be in accordance with the AISC Code of Standard Practice.

E. Provide temporary guy lines, bracing, and shoring as required, to maintain stability and alignment until the entire system (including metal deck erection) is erected, permanently connected, braced and set.

F. Any and all misfits shall be reported to the Engineer for resolution. Burning of new or unfair holes or cutting with a torch will not be permitted without the approval of the Engineer. Reamers, twist drills and saws shall be employed where burning is prohibited.

G. Any member that has assumed a bend or buckle in its final position due to forced fit shall have one or both ends and any intermediate connections unbolted and re-drilled or reamed to relieve such bowing to the satisfaction of the Engineer.

H. No piece that has been bent, broken, twisted or otherwise damaged shall be incorporated into the work. Such pieces shall be repaired or corrected on the ground to the satis-faction of the Engineer or replaced with a new piece. Failure to observe this will be cause for rejection of the piece in place.

I. Prior to the erection of any steel, the Contractor shall verify the location, elevation and plumbness of all anchor bolts and concrete surfaces. The Contractor shall report immediately to the Engineer in writing any condition which he finds unacceptable or that would prevent erection of the structural steel within AISC tolerance for plumbness and elevation. The Contractor shall be responsible for all corrections, and all corrections shall be made in a manner acceptable to the

Engineer.

J. The erector shall acquaint himself with all conditions at the site which can affect his methods and sequence of operations. Abide by Owner's regulations concerning traffic, parking and construction material delivery.

K. FIELD TOUCH-UP BY STEEL ERECTOR: Field bolts, field welds and abrasions to the shop coat shall be repaired and painted by the structural steel erector using the same paint and care as for shop coat. All such surfaces shall be washed with a suitable degreasing solvent. This contractor shall also remove any and all accumulations of mud, clay, rust, scale, grease, etc. that have been acquired, for any reason, during shipment, storage and erection and the shop coat restored to its original condition.

L. Sub-base (levelling) plates under column base plates will not be permitted.

M. Install headed studs using manufacturer approved equipment in accordance with the manufacturer's instructions.

N. Furnish all anchor bolts for anchorage of structural steel at an advance date for incorporation into the concrete foundation by others. Provide heavy hex nuts and washers for each bolt. Anchor bolts shall not be installed until shop drawings have been reviewed.

O. Observe all federal, state and local laws and area trade rules in the erection and handling of structural steel.

3.2 CLEANING UP

A. Upon completion of erection, promptly remove all tools, equipment and rubbish caused by or resulting from the erection work.

3.3 TESTING

A. All testing shall be by a testing agency approved by the Engineer, performed by registered/qualified technicians. The Contractor will employ the testing agency.

B. Test shop and field welds as indicated below:

1. All complete penetration welds shall be tested for 100% of the total weld length using ultrasonic testing apparatus.

2. All partial penetration welds shall be tested for 50% of the total weld length using the magnetic particle method.
3. 20% of all fillet welds shall be tested using the magnetic particle method.
4. All welds shall be visually inspected.

C. Inspect and test bolted connections; (see Section WM21.1, 3.01C). A minimum of 10 per cent of the bolts (and no less than 2 bolts in each connection) that are tightened per paragraph 3.01C, 2 shall be tested.

D. Inspect and test headed anchor studs and shear connector studs in accordance with the provisions for quality control of shear connectors, "Structural Welding Code", AWS D1.1.

E. Test reports shall be prepared by the testing agency giving the following:

1. The type and location of test conducted.
2. The test results.
3. Interpretation of the test results stating whether they comply with the Specification requirements.
4. Procedure taken if the test results are not acceptable.
5. Test results of re-tests after corrective measures have been completed. The cost of all re-testing of faulty welds shall be borne by the Contractor.

PART 4 - PAYMENT

4.1 METHOD OF MEASUREMENT

A. There will be no measurement for structural steel fabrication and erection.

4.2 BASIS OF PAYMENT

A. There will be no separate payment for structural steel fabrication and erection.